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THE HUMAN SIDE OF MINING ENGINEERING

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THE HUMAN SIDE OF MININC ENGINEERING

An Address by

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JAMES FURMAN KEMP, E.M., Sc.D., LL.D.,

Annual Commencement Address, May 24, 1918

In this year of our Lord, nineteen hundred and eighteen, you are holding Commencement under conditions different from any previously experienced by the School of Mines. Under those which have hitherto prevailed a scientific theme would be appropriate for this address. There are many such. Geology has so enwrapped itself in the very fiber of the mining industry that the themes concerned with structure and origin are fundamental. Yet in its period of hot, volcanic feeling, when all over the broad land which with solemn pride we call our own, all good men and women are asking but the one question, what can we do to serve, it is the human questions which alone seem appropriate for discussion, and it is to the human side of relations between workers, whether they are in the office or in the mine, on the surface in the sunshine and the daylight or underground with the searching ray of the carbide lamp, that I desire to direct your thoughts. You who graduate today, just as those who have taken their diplomas at previous commencements, will sooner or later have to meet the problems presented to and by the workers. You observe that I make no distinctions among workers. We are all workers.

The old relations which have prevailed among the people engaged at our mines, even if the enterprise be of but modest size, have not proved all that our bright fancy might paint. They are not all that could be wished, but as time goes by, they will undergo improvement. Many thoughtful observers realize this truth to the full. At the annual dinner of the American Institute of Mining Engineers last February, President-elect Sydney Jennings, in announcing the subject which he planned that the Institute should specially discuss during his year of office, selected the human side of the industry and the improvement of conditions. It was a striking coincidence of which Mr.

Jennings was not, I believe, at the time aware, that only a few days before in a pamphlet issued to his people, President Shonts of the Interboro Company which controls in large degree the subways and elevated railroads of New York City, had taken the ground that the human side of their relations must now come up for more serious and continuous attention and for improvement.

These problems are fundamental and the fundamental nature of them comes home to us with exceptional force at a time like the present, when we are all called to rise as one man to the defence of our country. We have prided ourselves on the fact that every citizen in it could truthfully say and feel, "it is my country" and could have good reason for the belief that is in him. Its normal conditions assured him reasonable justice and a fair opportunity to work out his own career. We solve our problems of government with human and necessarily imperfect instruments. Imperfect and partial results are obtained. But the great, important and basal feature of it all, is the conviction deep down in each individual's mind, that he has a free and fair field, and that where wrong exists, as wrong is bound to exist more or less in human life, means are also provided wherewith to right it. If therefore not in war times but in normal times, we can labor to strengthen that fundamental conviction, we prepare for those sudden, almost unbelievable upheavals, veritable earthquakes in human affairs, such as the present one with which German ambitions and unbridled selfishness have confronted us. Our people are responding with such widespread singleness of purpose as to convince us that the course of life in the past in America has prepared a united front in the defence of democracy against its most dangerous, unscrupulous and insidious foe. President Wilson has gone right to the heart of the matter and his epigrammatic and concise summaries have the convincing force of proverbs, for a proverb, you know, has been acutely defined as the wisdom of the many but the wit of one.

We are to consider for a few moments the ways in which a mining engineer can so conduct the enterprise under his control or in which he shares as to secure the loyalty of all the workers to the company or firm controlling it; and to make them good and loyal citizens.

Mining and metallurgical enterprises in a large proportion of cases differ from other industries. They are often in remote places. The community is built up around the mine or group of mines or around the smelter. The manager must not only employ and pay, but house, feed and educate. Let me give you one or two illustrations, not necessarily drawn from America.

When the International Geological Congress of 1910 was held in Stockholm, Sweden, an excursion was given the delegates far to the north to the great iron mines at Kirunavaara, situated over a hundred miles north of the polar circle in Swedish Lapland. At Kirunavaara—under the leadership of Dr. Hjalmar Lundbohm, formerly of the Geological Survey of Sweden—a huge sheet shaped mass of magnetite had been developed, that is very nearly if not quite the largest single body of iron ore yet discovered the world over. A remoter situation could hardly be conceived, nor, in the winter, severer climatic conditions. From a great though somewhat diversified plain there rises to a height of some hundreds of feet the ridge whose backbone for several miles is the great sheet of iron ore, lying with a dip of 70 degrees between other sheets of contrasted eruptive rock. At the foot of the ridge in 1910 a community of five thousand souls had been established. There were a thousand children in the schools, and the school-houses in which the eight or ten score excursionists were fed were beautifully constructed and equipped. The houses of the workers were comfortable and convenient so that to the most superficial observer it was evident that Dr. Lundbohm had been moved by an almost pastoral care of his flock.

On the day on which we were conducted along a mile or more of the outcropping ore and while the other members of the party were busy collecting from the ore, the hanging wall and footwall, I sat for a brief space apart by myself and studied over the Arctic expanse of stunted trees, moraines, swamps and lakes. But continually my thoughts would come back to those five thousand people, men, women and children, all drawing their support from the mine. There they were, placed right in the hand of the General Manager, and his opportunity as well as his responsibility for more than food and clothing were very great. There was a little, organized state in miniature, and much more than Swedish kroner in dividends was involved in the way their lives were directed.

Let me ask you to turn your eyes next to the West for two more illustrations. The flourishing little city of Anaconda, Montana, gathers around the Washoe Smelter, or as the company now officially calls it, smeltery. You could not be a half-hour in Anaconda without hearing the name of E. P. Mathewson, until recently the manager of the works, and now moved by the exigencies of the war and his Canadian citizenship to develop a new company for the production of nickel in the Sudbury district, Ontario. But Anaconda is Mr. Mathewson's masterpiece—and we see not alone a great and thoroughly organized smelting plant, but good homes, good roads, a park, a

fish-hatchery, and a hundred other signs of wise and far-sighted management. One also finds a singularly devoted staff of workers, reaching into the thousands and animated by one spirit of loyalty. We understand why the Mining and Metallurgical Society of America awarded its gold medal to him in 1917. Mr. Mathewson passed on to his successor not alone the management of the great works but responsibilities not unlike those of bishop of a diocese.

Were you to go farther west to the valley of the South Fork of the Coeur d'Alene river, deep down between the mountain ridges of Idaho, you would find the trim little town of Kellogg, centering about the mines, mill and smelter of the Bunker Hill & Sullivan Company. Homes for the workers with a plot of ground, which can be bought from the company under favorable terms, are the striking feature to a visitor. Instead of the slovenly cabins, and unattractive boarding houses so often the rule in western mining camps, one notes comfortable homes with little gardens in which a miner and his family may take pride. In these as well as in other ways in connection with this mining enterprise, the wisdom of Mr. Stanley Easton's far-sighted management become impressed on an observer.

As I have stated, mining and metallurgical communities are isolated as compared with those dependent on other forms of industry to a degree not often the rule in other lines of employment. The miner also works either by himself or in small groups, usually underground, often in confined places that may be wet or that may be sultry and hot, and that often involve some personal risk; air is frequently bad. We cannot wonder if, when he comes to the surface, the miner more than other workers craves excitment and change. If a saloon is available, the poor man's club, as it has been wittily called, he resorts naturally and inevitably to it, and in the social companionship of his fellows, seeks in the artificial excitement of stimulants, the change for which he not unnaturally longs. If he is in a small and isolated place, there is nothing to do in the evening or other off-shift part of the time but to sit around the bunk or boarding house, where rarely is there provision of magazines or illustrated papers, and where a hand at cards furnishes almost the sole recreation. In such instances, and they are legion in the West, he waits till the end of the week or month and condenses into a wild few hours the accumulated and not unnatural cravings of days or weeks.

Something surely can be done to meet in a proper and unobjectionable way a need that none can deny. Club-houses or club-rooms at once suggest themselves as the natural solution. Prohibition will soon wipe out the open and above-board saloon

and reduce almost to the vanishing point the old means of indulgence . The need of some substitute will be more imperative in the near future than it has been in the past. A social center must be provided. Magazines and illustrated papers are something. Games of cards without money-stakes have no real objections and would be enjoyed by many. A social glass of non-alcoholic drinks will answer for good fellowship as well as does fire water, if prejudice can once be overcome. A quiet smoke over an open fire in congenial groups in comfortable chairs is no impracticable dream. Something like bowling alleys or billiards suggest themselves at once.

All these, however, must not be provided as a gratuity or donation by the management for, if so, they would thwart their own good purpose at the outset; but they must be run like any club by the members, all sharing. Expenses must be borne in some reasonable division by participants. The sense of ownership and responsibility must be cultivated, for otherwise in the American atmosphere movements of this kind made with the best intentions by the management of companies or the heads of firms have proved flat failures. I recall one beautiful memorial club house erected by the families of two departed members of a great firm in a somewhat isolated mining town and placed under the charge of a well-meaning and devoted retired clergyman. The reverend gentleman thought it wrong for the men to play cards or smoke in the building and hedged it around with such restrictions that no miner could have been dragged to its doors by the police.

A strong and successful movement for the establishment and acceptable management of club houses and social centers by the Young Men's Christian Association has been for some years in progress and has been in instances very successful. The club houses which were placed under its auspices at all the communities of workers along the Panama Canal during its construction were invaluable and a great means of good. Conditions there were similar to those at many great but isolated mines. Bowling alleys, amusement rooms and reading rooms furnished veritable oases in the desert and were a great source of good. Similar club houses are not unknown in mining communities. One at Miami, Arizona, has for some years kept open hospitable doors.

These social centers must be managed with care in one respect, since miners are of all religious faiths and none, of all nationalities and often of strong prejudices; and the social worker in general charge must have so broad and comprehensive a human spirit that his love for his fellowmen as men is not fenced in by limitations of creed. A very useful

help in good works centering around a social center can be found in the omnipresent fondness of Americans for out-door or indoor, wholesome sport. Teams from neighboring mines, or from different shafts of the same mine, or from surface-men and underground men, or from any other groups who form natural centers, can be recruited and be a fruitful source of proper entertainment. There may not always be level ground for basefall or soccer, but the narrowest valley is not so narrow as to crowd out quoits; and in a club-house the bowling alley may furnish a safety valve for much good-natured rivalry.

You cannot fail to note that I only urge for mining communities what has sprung up naturally and universally as adjuncts to our training and fighting camps of troops here and abroad—social centers, reading rooms, athletic fields and sports, inter-regimental, divisional or other rivalry at base-ball and other games. All operate to good discipline and make lighter the disagreeable features and montony of a soldier's, as they would also of a miner's life.

One feature of our western mining communities cannot fail to impress one who lives in them. It is a feature less marked in the older and more settled districts of the East and of Lake Superior. It is the wide-spread feeling that the community is a transitory one, conditions are temporary, ore will be exhausted and everyone will move on elsewhere. The disposition is thus to accumulate a stake and depart to some other place in which to settle down. Where mines, however, are known to have great reserves for years to come, one of the most important efforts of the management might well be to break this feeling and get all concerned to look upon the community as their settled home. Now the foundation of the State, as we all well know, is the family. Unless we have a vast predominance of reasonably happy and contented families in which young people grow up under wholesome surroundings, we cut off at the source our supply of good citizens, men and women. Our so-called and significantly called, mining "camps" have too little family life and are too little populated by families and too much by hobo miners. A most important phase of the whole subject is for the management of the companies which are large enough and permanent enough to justify the movement to give no small part of their attention to establishing comfortable and reasonably attractive homes, which, where possible with a little tract of land, may be acquired by a miner and felt to be his own. There is no stiffener of backbone or strengthener of character greater than owning a piece of land and in spare times growing supplies for the table from a bit of a garden located upon it. The miner with a home and a family

has a stake in the game and becomes a self-respecting citizen. Not every mining locality is adapted to this development. The great Utah Copper Comany, brought into successful operation by your distinguished graduate, Mr. D. C. Jackling, is placed far up the narrow Bingham Canon, amid physical conditions precluding little homes and gardens. Suitable land in the dry climate of Utah is too far away to admit of transportation to and fro. But at Kellogg in the Coeur d'Alene as I have earlier stated, the Bunker Hill and Sullivan Company in a broader valley has accomplished impressive results in building and selling at attractive and reasonable terms, homes to the men. No doubt there are other instances, but in general where settlements can be feasibly established in reasonably flat and open country within practicable distance for transportation, to and fro, we must feel that no more important development could be carried on by the management than to give its attention and a part of its resources to the housing of its men under these circumstances. A company could thus assist in carrying out the scriptural injunction of setting the solitary in families. We would reproduce in this way some of the attractive features of the mining towns in Cornwall, the Mother of metal mining among English speaking peoples, and of Wales, to whose miners we so largely owe the early development of our coal fields.

The Welsh have another suggestion to give us. They are remarkable singers in chorus, a characteristic not only of the Welsh in Wales but of the Americans of Welsh descent in Pennsylvania. In England, in the choral contests which have been held in former years by choruses from various parts of Great Britain, the Welsh have been almost invincible. The "Cousin Jacks" are rather notable singers of hymns in the old country, nor has it been altogether unknown in former years, to have groups of good Methodists from among them in the Lake Superior copper mines, start up a hymn as they were lowered in the cage down the very deep shafts of this region. Italians are famous as a people of song—and they furnish no negligible part of our miners today. Folk-songs are also characteristics in their home country villages of many other lands which send us miners. I cannot believe it is an impracticable pipe-dream, that some of these latent possibilities of song and chorus singing could be developed under the bright skies and amid the impressive mountains of the West. Children, at all events, where they are members of a mining community, have great possibilities for choral singing under proper instruction. Last winter in a little town in Florida, we sojourners seeking relief from the rigors of a northern winter and our neighbors who lived there all the year round, were gladdened and raised quite

out of the dead level of life amid the sand-dunes, because a cultivated English woman, of early musical training, brought the children together for some weeks before Christmas and taught them the beautiful Yuletide carols of the old country and of other lands. Had you heard, as I did, the old-time English songs, the Noel of the French, and the Holy Night, the product of a long-vanished time in Central Europe, you would have wrung the teacher's hand as I did, in congratulation over her happy thought. While there are youthful trebles, there must unquestionbly be sonorous basses and highpitched tenors in our larger mining communities awaiting the magic touch of the conductor's wand.

In all organizations of men which hold effectively together we need some sort of rewards and some sort of recognition for long and good service. To a certain extent these rewards come now in promotion for those who show qualities of leadership which make them available as shift bosses or foremen; but only a man here and there is adapted to these positions. The general run of men work on with no possibilities of recognition. I have pondered the question a bit, as to whether some progressive recognition could not be provided by some increase in pay. —or some keepsake that would commemorate it. I realize that to some, perhaps a serious extent class-feeling and the disposition sometimes shown by unions to keep all their members on a dead level of compensation would militate against it. And yet the system of rewards for good work appeals to just as deeply ingrained a characteristic of human nature as does discharge or other penalties for poor work. In almost all cases we have the latter, but we seldom hear of the former. Are we not thereby overlooking a very important phase of the whole situation?

In a recent address to the Montana Section of the American Institute of Mining Engineers at Butte, to which in common with many others I listened with deep attention, President Jennings of the Institute emphasized the great importance of getting the workers of all sorts in our mines and smelters to exercise their wills for the good of the organization. He defined the problem as one to secure the wills in the service of the employer. Perhaps in the topics which we have already covered there may be a suggestion or two leading to this end, in that all the points made emphasize the importance of supplying conditions of life conducive to reasonble satisfaction and contentment. President Jennings touched on another phase which is one that, doubtless as have others, I have often pondered, and that is summed up in the employer's privilege to hire and fire at will. This is a privilege often exercised very harshly by shift bosses and minor officials, and as President

Jennings pointed out, it starts a man away from his means of support, breaks up his home if he has one, and causes him injury often quite disproportionate to his offence. He may be a poor miner and be not adapted to the work of this particular type, but he may be well enough adapted to some other branch of employment. It is well therefore to think seriously whether, if a man is reasonably industrious and otherwise deserving, some kind of work suited to him cannot be found before his connection is absolutely severed. In other words can we not introduce the human element into mining engineering? Shift bosses and minor officials are often greatly impressed with the powers of authority and are sometimes very harsh and hasty in its exercise. On the other hand discipline must be maintained. Perhaps I may commend to you as a subject worthy of a little serious thought, whether there is not some way possible of maintaining necessary discipline and yet supplying a tribunal of some sort which will command confidence and which will give a fair hearing to cases involving at least the temporary loss of livelihood. I am inclined to think that the most important part of the "Safety First" movement is one to which so far as I know, practically no reference has been made under this watchword, and that is the safety of a deserving man in his job. The one great thing to keep out of his mind is the smarting sense of wrong and injustice. The fierce, individualistic conditions of a new country like our own, are fast giving way to more settled ones such as prevail in older nationalities. The sense of security in a job is greater in the older communities, and it has its good side even for the more restless and changing life of our own.

Some of our smelting companies, such as the United States Steel and the International Nickel have sought with good results to make all the workers participants in the returns of profits. Shares of stock in the several companies have been offered the workers on favorable terms and under such conditions that a portion of the monthly wage could be applied for their purchase. A community of interest is thereby established and much has been done to attach to the company's welfare the "wills" of the men—the securing of which President Jennings described as a step so greatly to be desired. This plan also meets a condition laid down by President Ripley of the Santa Fe Railroad at a dinner given in his honor in Chicago on his seventieth birthday. He established as a principle in the management of great enterprises such as his own, that changes or improvements must be so planned as to be to the common advantage of all concerned. We know well that this applies also in mines and smelters and finds expression in sliding scales of

wages based on the market price of metals. A rise in price that is accompanied by benefits all around, leads to satisfaction rather than discontent. A fall in price leads to community in suffering to all concerned. While, alas, experience shows us that the spiritually beneficial effects of the latter form of suffering are less appreciated by the wage-earners than the stockholders, yet, after all, kinship is established by this touch of Nature.

Gentlemen of the Graduating Class, it is an ancient profession and a great work to which in time and as you reach places of responsibility you will be addressing yourselves. If you gain the positions of management as past experience with graduating classes leads us to think you will, the problems outlined in these last few minutes will come up for solution. Others have found a way. Let me wish you all success in so doing and by way of encouragement I will close with an incident. On May 12, 1907, in the New York Botanical Garden we celebrated the 200th anniversary of the birthday of the great Swedish botanist, Linnaeus, the Father of Modern Botany, by dedicating in his memory a beautiful bridge over the Bronx River. Not a few distinguished citizens of Sweden were there and some were entertained at lunch by the authorities of the Garden of whose Board of Scientific Directors I had been a member for fifteen years. The honor fell to me to serve as escort at the lunch to his Excellency M. de Lagerkrantz, the Minister of Sweden to the United States. For fifteen or twenty minutes we did our best to carry on a conversation that would be of mutual interest. Unavoidably the task grew somewhat labored, when a chance remark revealed the fact that in his home M. de Lagerkrantz owned and operated iron mines. Like magic the conversational situation changed and the luncheon came to an end before we had either of us said half the things that rose in our minds. One remark of his Excellency I never forgot. He said that when he was leaving his home amid the iron mines to start for America, his men came down to the train to say good bye. With tears in their eyes, they bade him not to tarry over long in America, but to return to his own people as soon as he could. The manager or the owner of a mining enterprise sometimes, as you see, has also been the guide, counselor and friend of his people.

The really great man, whether in national life or in the responsible places in industry, is the one who understands his people and gives his best endeavor to surround them with such conditions that their reasonable and proper aspirations may find expression. Of all the men of prominence whose lives have come within the ken of people still living, our venerated Presi-

dent Lincoln is the one who best meets these conditions. Whether we come from the South or the North we must look back from the vantage ground of fifty years almost in wonder at the calm poise which always looked into the future for a united country of devoted citizens from whose hearts and minds the hot passions of war would vanish and in whose thoughts more wholesome, more helpful, onward-moving plans would take their place. In the same way in industry the large-minded and far-seeing manager is one who to be sure does not fail to realize that mining is a business, conducted for profit, exposed to competition, subject to strikes, often to unreasonable demands from the ignorant or the unscrupulous, but who does not thereby become blinded to the fact that he has in his employ not merely hands, but souls, not merely instruments from which to extract a full amount of work for the current wage, but citizens, the foundation of the state. As he interprets and meets their good aspirations, insures them just rewards, realizes that only a pair of stout hands and a job stand between them and want, that many are ignorant, that many are in a foreign land with small command of its language, with smaller knowledge of its customs, its history, its life, exposed often to petty graft almost impossible to detect and eradicate, he is called upon to exercise scarcely less than the far-sighted patience and the faith which we see in the deep-set, sad eyes of our first martyrd president.

COMMENCEMENT ADDRESSES
1901-1918

1901 The Development of American mining and metallurgy, and the equipments of a training school. James Douglas, LL.D., President, Copper Queen Mine. (Out of print).

1902 Mining and metallurgy in some of their relations to the progress of civilization. William P. Blake, F.G.S., Director, Arizona School of Mines. (Out of print).

1903 Science and practice. Regis Chauvenet, LL.D., Mining Engineer. (Out of print).

1904 The Engineer and his relation to modern methods. Charles J. N. Norwood, M.Sc., Director, Kentucky Geological Survey. (Not published).

1905 Ore treatment in the southeast Missouri lead district. Oscar M. Bilharz, E.M., Chief Engineer, St. Joseph Lead Co. (Not published).

1907 Compound numbers. John Henderson Miller, D.D., Kansas City. (Not published).

1908 The Human side of an engineer's life. Edmund B. Kirby, E.M., Consulting Mining Engineer.

1909 The Relation that exists between general and technical education. A. Ross Hill, LL.D. President of the University. (Not published).

1910 Some of the essentials of success. Charles Sumner Howe, LL.D., President, Case School of Applied Science.

1911 The individual, the state and the nation in the development of our mineral resources. Joseph Austin Holmes, LL.D., Director, U. S. Bureau of Mines. (Not published).

1912 Mining and civilization. James Ralph Finlay, A.B., Consulting Mining Engineer.

1913 Measuring the output. Edwin Earle Sparks, LL.D. President, Pennsylvania State College. (Not published).

1914 The West. Frank Strong, LL.D. Chancellor, University of Kansas. (Not published).

1915 Place and influence of the engineer. Elmer James McCaustland, M.C.E., Dean of the School of Engineering of the University. (Not published).

1916 The Business of mining. Walter Renton Ingalls, S.B. Editor, The Engineering and Mining Journal.

1917 What should a present day metallurgical education comprise? Charles Herman Fulton, D.Sc., Professor of Metallurgy, Case School of Applied Science.

1918 The Human side of Mining Engineering. James Furman Kemp, LL.D., Professor of Geology, Columbia University.

BULLETINS OF THE MISSOURI SCHOOL OF MINES

General Series

Vol. 1, No. 1, Dec., 1908. The human side of a mining engineer's life. Edmund B. Kirby. (Commencement address, June 10th, 1908.)

Vol. 1, No. 2, 38th Annual Catalogue, 1909-1910.

Vol. 1, No. 3, June, 1909. Education for utility and culture. Calvin M. Woodward. (Tau Beta Pi address.)

Vol. 1, No. 4, Sept., 1909. The history and the development of the Cyanide process. Horace Tharp Mann.

Vol. 2, No. 1, Dec., 1909. The Jackling field, School of Mines and Metallurgy.

Vol. 2, No. 2, 39th Annual Catalogue, 1910-1911. (Out of print.)

Vol. 2, No. 3, June, 1910. Some of the essentials of success. Charles Summer Howe. (Commence address, June 1st, 1910.)

Vol. 2, No. 4, Sept., 1910. Friction in small air pipes. E. G. Harris, Albert Park, H. K. Peterson. (Continued by Tehnical Series. Vol. 1, No. 1 and 4.)

Vol. 3, No. 1, Dec., 1910. Some relations between the composition of a mineral and its physical properties. G. H. Cox, E. P. Murray.

Vol. 3, No. 2, March 1st, 1911. 40th Annual Catalogue, 1911-1912.

Vol. 3, No. 3, June, 1911. Providing for future generations. E. R. Buckley. (Tau Beta Pi address May 24th, 1911.)

Vol. 3, No. 4, Sept., 1911. Fall announcement of courses. (Out of print.)

Vol. 4, No. 1, Dec. 1911. Fortieth anniversary of the School of Mines and Metallurgy of the University of Missouri. Parker Hall Memorial address. Laying of cornerstone of Parker Hall, Rolla, Missouri, October 24th, 1911.

Vol. 4, No. 2, March, 1912. 41st Annual Catalogue, 1912-1913.

Vol. 4, No. 3, June, 1912. Mining and civilization. J. R. Finlay. (Commencement address, May 31st, 1912.)

Vol. 4, No. 4, Sept., 1912. Fall announcement of courses. (o. p.)

Vol. 5, No. 1, Dec., 1912. Student Life.

Vol. 5, No. 2, March, 1913. 42nd Annual Catalogue, 1912-1913.

Vol. 5, No. 3, Never published.

Vol. 5, No. 4, Never published.

Vol. 6, No. 1, Never published.

Vol. 6, No. 2, March, 1914. 43rd Annual Catalogue, 1913-1914.

Vol. 6, No. 3, Never published.

Vol. 6, No. 4, Never published.

Vol. 7, No. 1, Never published.

Vol. 7, No. 2, March, 1915. 44th Annual Catalogue, 1914-1915.

Vol. 7, No. 3, June, 1915. Description of special courses in oil and gas and allied subjects.

Vol. 7, No. 4, September, 1915. Register of graduates, 1874-1915.

Vol. 8, No. 1, Jan., 1916. Bibliography on concentrating ores by flotation. Jesse Cunningham.

Vol. 8, No. 2, March, 1916. 45th Annual Catalogue, 1915-1916.

Vol. 8, No. 3, June, 1916. The Business of mining. W. R. Ingalls. (Commencement address, May 26, 1916.)

Vol. 8, No. 4, October, 1916. Register of graduates, 1874-1916. (Out of print.)

Vol. 9, No. 1, Jan., 1917. Road problems in the Ozarks. E. G. Harris. Bibliography on rural roads. H. L. Wheeler.

Vol. 9, No. 2, March, 1917. 46th Annual Catalogue, 1916-1917.

Vol. 9, No. 3, June, 1917. What should a present-day metallurgical education comprise? Charles Hermann Fulton. (Commencement address, May 25, 1917.)

Vol. 9, No. 4, October, 1917. Register of graduates, 1874-1917. M. S. M. men in military service.

Vol. 10, No. 1, Never published.

Vol. 10, No. 2, March, 1918. 47th Annual Catalogue, 1917-18.

Vol. 10, No. 3, June, 1918. The Human side of mining engineering. James Furman Kemp. (Commencement address, May 24, 1918.)

Technical Series

Vol. 1, No. 1, November, 1911. Friction in air pipes. E. G. Harris. (Continuation of General Series, Vol. 2, No. 4.)

Vol. 1, No. 2, February, 1912. Metallurgy and ore dressing laboratories of the Missouri School of Mines and Metallurgy. D. Copeland, H. T. Mann, H. A. Roesler. (Out of print.)

Vol. 1, No. 3, May, 1912. Some apparatus and methods for demonstrating rock drilling and the loading of drill holes in tunneling. L. E. Young.

Vol. 1, No. 4, August, 1912. Friction in air pipes. E. G. Harris. (Continuation of Vol. 1, No. 1, November, 1911.)

Vol. 2, No. 1, August, 1915. Comparative tests of piston drill bits. C. R. Forbes and L. M. Cummings.

Vol. 2, No. 2, November, 1915. Orifice measurements of air in large quantities. Elmo G. Harris.

Vol. 2, No. 3, February, 1916. Cupellation losses in assaying. Horace T. Mann and Charles Y. Clayton.

Vol. 2, No. 4, May, 1916. Geologic criteria for determining the structural position of sedimentary beds. G. H. Cox and C. L. Dake. (Out of print.)

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Vol. 3, No. 2, November, 1916. Studies on the origin of Missouri cherts and zinc ores. G. H. Cox, R. S. Dean, and V. H. Gottschalk.

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